



ASMEX.137C1

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Raaijmakers
Appl. No.	:	09/584,656
Filed	:	May 30, 2000
For	:	APPARATUS FOR THERMAL TREATMENT OF SUBSTRATES
Examiner	:	Leonard R. Leo
Group Art Unit	:	3753

DECLARATION OF PRIOR INVENTORSHIP
UNDER 37 C.F.R. §1.131

United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Ivo Raaijmakers, do hereby declare and say as follows:

1. I am the named inventor of the subject matter of the above-identified U.S. Patent Application, No. 09/584,656, filed May 30, 2000.
2. I am the sole inventor who contributed to the development of the presently claimed invention.
3. I have read the Office Action mailed June 3, 2004, and understand that Claims 53-55, 59, 65, 68-69 and 71 have been rejected by the Examiner under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,300,600 B1 to Ratliff et al. ("Ratliff et al."), claiming priority from Provisional Application No. 60/096,283, filed on August 12, 1998, in view of U.S. Patent No. 5,199,483 to Bahng.
4. I conceived of the subject matter of the present application prior to August 12, 1998 and, therefore, prior to the claimed priority date of Ratliff et al.
5. Exhibit A is a photocopy of an invention disclosure that describes the invention claimed in the present application. I signed the invention disclosure prior to August 12, 1998.

Appl. No. : **09/584,656**
Filed : **May 30, 2000**

6. From before August 12, 1998 until filing of a patent application on September 10, 1998, I worked diligently with the patent attorneys to prepare the application and to ensure that it accurately represented the invention.

7. Exhibit B is a photocopy of a letter to me from Gordon Olson, a patent attorney who supervised preparation of U.S. Patent Application No. 09/150,986, the parent application to U.S. Patent Application No. 09/584,656. The letter was dated June 2, 1998. I subsequently reviewed the draft of the application for completeness and accuracy and communicated with the patent attorneys.

8. Exhibit C is a photocopy of a letter to me from Gordon Olson, indicating that an additional draft of the application was produced after receiving my comments. The letter was dated August 31, 1998.

9. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. I declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

July 9, 2004
Date


Ivo Raaijmakers

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**RECORD OF INVENTION
AND INVENTION DISCLOSURE**

1. *Title of Invention:*

Method and Apparatus for Fast Cool Down of Semiconductor Wafers

2. *Inventor(s):*

<u>Full name</u>	<u>Citizenship</u>	<u>Residence</u>	<u>Postal Address</u>
Ivo Raaijmakers	Dutch	2741 E. Big Horn Ave. Phoenix, AZ 85048	ASM America 3411 E. Harbour Dr. Phoenix, AZ 85034

3.

<u>Place(s)</u>	<u>Inventive Circumstances</u>
Phoenix	Meeting.

4. *Initial drawings or sketches and written description of the invention:*

<u>Date</u>	<u>Circumstances</u>
-------------	----------------------

None

<u>Place</u>	ASM America, Inc. - Phoenix, AZ
--------------	---------------------------------

5. *Initial disclosure of the invention to others:*

<u>Date</u>	<u>Place</u>	<u>Person(s) receiving disclosure</u>
-------------	--------------	---------------------------------------

None, other than fellow employees.

Circumstances

<u>Date</u>	<u>Place</u>	<u>Person(s) receiving disclosure</u>
-------------	--------------	---------------------------------------

Circumstances

EXHIBIT A

6. Initial tests, uses or operations of the invention:

Date

Place

Person(s) present

Circumstances

7. What is the closest "prior art"; that is, what devices, technologies, structures, processes, information or materials which existed publicly or privately before the invention was made are considered to be most closely related to the invention? Each person identified in Paragraph 2 should answer this question.

Date

Place

Person(s) involved

Circumstances

8. Other than the initial disclosure described in paragraph 5, has the invention ever been disclosed orally or in writing to any person other than the fellow employees? If so, provide the following information:

Date

Place

Person(s) receiving disclosure

None.

Circumstances

9. Has the invention ever been used commercially for any purpose? If so, provide the following information

Date

Place

Person(s) involved

Circumstances

10. Are any disclosures planned for the near future?

Planned Disclosure

Approximate date

Circumstances

11. Identify any identities who sponsored or paid, in whole or in part, for the work that led to the conception or reduction to practice of the invention.

Entity

Nature of Sponsorship

Circumstances

None.

- (1) **BACKGROUND.** Describe the field to which the invention relates and explain what is wrong with the prior art. Provide sufficient background information to enable the reader to clearly appreciate the problems that existed prior to the invention.

In many high temperature CVD processes, the wafer has to cool from the process temperature to a much lower temperature before a wafer can be placed or picked up by a handler. For example, in a state of the art Epi System like the ASM Epsilon 2000, process temperatures are in the range of 1000 - 1200°C, while the wafer handling temperature is only 900°C. It will take the susceptor and/or wafer time to cool down. Measured Cool Down rates are typically 12 seconds from 1200 - 900°C for a low mass susceptor, and about 45 seconds for a standard susceptor. This time adds to the total cycle time and hence decreases the throughput of the system. This will increase the cost of wafer processing. It is the intent of the current invention to provide a method and apparatus to cool down a susceptor, a susceptor with wafer or a wafer fast and in a uniform fashion from a high process temperature to a temperature at which the wafer can be placed on or picked up from the reactor.

- (2) **DESCRIPTION.** Write a detailed description of the invention, referencing sketches, drawings or photographs. Describe the best way to carry out the invention

In one embodiment of the invention (see figure 1), a susceptor, wafer or a combination of both is supported by a "so-called" spider on at least three points. The spider and susceptor can rotate by an external drive mechanism. The external drive mechanism also has means to translate the spider / susceptor / wafer vertically. For the current invention, the extent that vertical travel is allowed is larger than usual. When it is desired to cool down the wafer, the wafer, susceptor, and spider are pushed up until they are in close proximity to the (relatively) cold upper wall of the reactor. The cold wall is made such that it is substantially parallel with the wafer / susceptor surface. At pressure above the transition point to molecular flow, the heat conductance of the gas is independent of pressure. At a gap of 1mm heat conductance through the gas phase is the dominant transport mechanism. Thus the wafer / susceptor will cool down much faster when in close proximity to the cold wall, then it does by radiation alone (far from the wall about > 20 mm), see figures 3 a and b.

In another embodiment of the invention (figure 2), a cold movable plate is kept in a pocket in a reactor. The pocket is water cooled. The spacing from the cold plate to the wall of the pocket is small so that the plate stays cool. The plate is mounted on an arm. When it is desired to cool the wafer / susceptor, the arm moves the plate over the susceptor such that the plate is in close proximity with the susceptor. The plate has preferably a much higher heat capacity than the wafer and/or susceptor. The wafer/susceptor will cool quickly by conductive and radiative heat transfer. When the wafer / susceptor is cold enough, the plate is moved to the pocket to return to its original idle temperature by radiative and convective heat transport to the cooled pocket wall. The wafer can now be picked up from the susceptor.

- (3) **ADVANTAGES.** List and explain the advantages of the invention in the order of their importance, and describe how the invention solves or overcomes the problems of the prior art. Include all possible uses and modifications of the invention. Speculate reasonably on any additional uses that the invention may have, either by itself or in combination with other known or as yet unknown technologies.

Advantage One -

The invention allows a wafer, a susceptor, or a wafer on a susceptor to cool significantly faster than by radiation alone (see figure 3). Also, since conductive heat transfer through the gas phase is dominant, and since the conductive heat transfer is only determined by the gas species (H₂ or He are preferred), the spacing, and the temperature difference between the wafer and the cold wall or plate cooling can be much more uniform than by radiation alone. This will decrease stresses in the wafer and susceptor during cool down.

The faster and more uniform cool down will allow a wafer to be picked up or placed on a susceptor sooner which enhances throughput and ultimately decreases cost of wafer processing.

13. I (we) verify that the foregoing is true and correct.

Inventor(s):

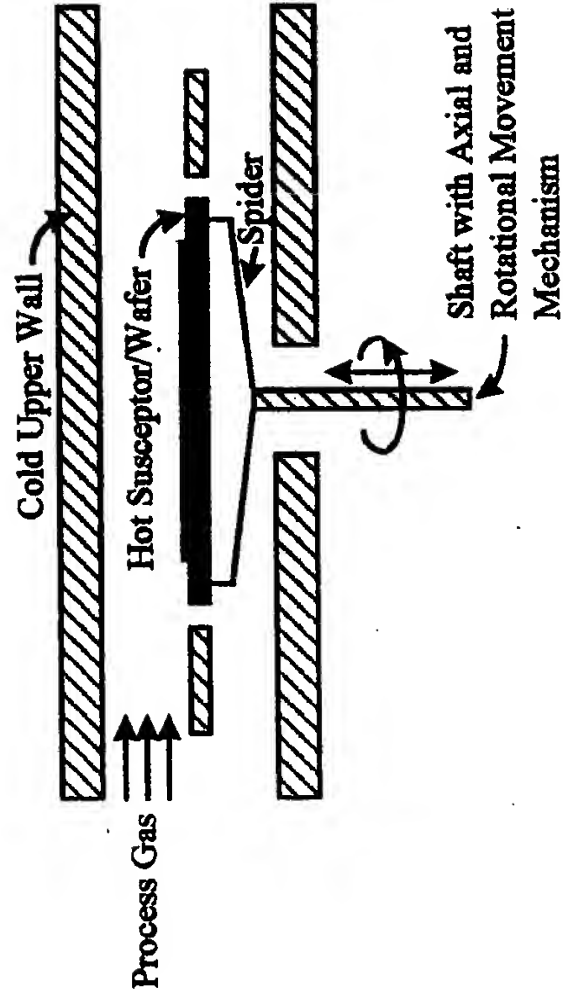
<u>Date</u>	<u>Signature</u>	<u>Printed name</u>	<u>Business Phone Number</u>
[REDACTED]	[Signature]	Ivo Raaijmakers	(602) 470-2955

Witnessed and Understood (two or more witnesses should sign):

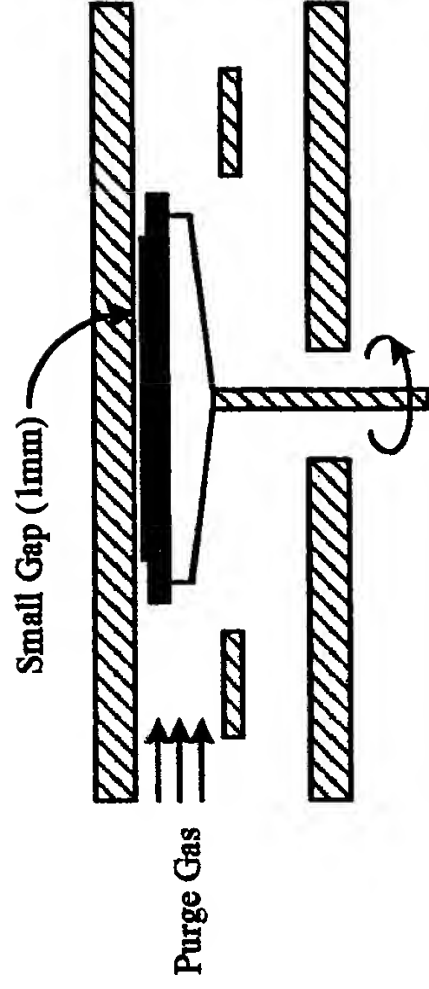
<u>Date</u>	<u>Signature</u>	<u>Printed name</u>	<u>Business Phone Number</u>
[REDACTED]	[Signature]	MIKE STAMP	(602) 470-2792
[REDACTED]	[Signature]	MICHAEL W. HARPER	602 470-2879

Embodiment 1 (Fig. 1)

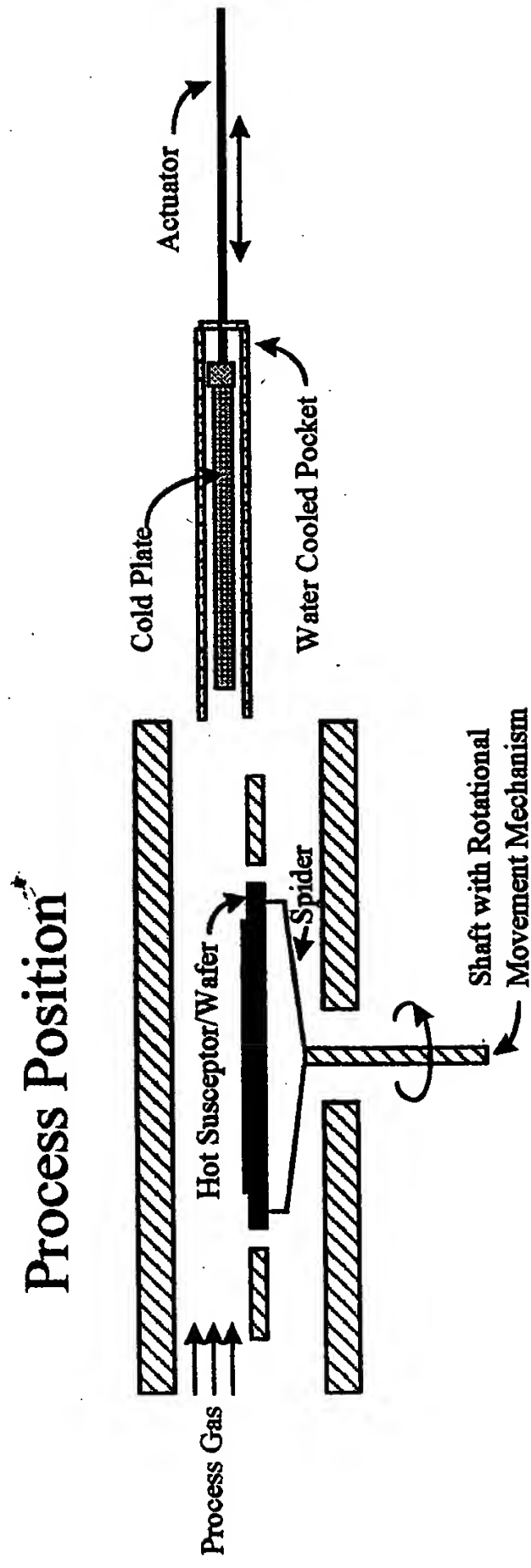
Process Position



Cool Down Position



Embodiment 2 (Fig. 2)



Cool Down Position

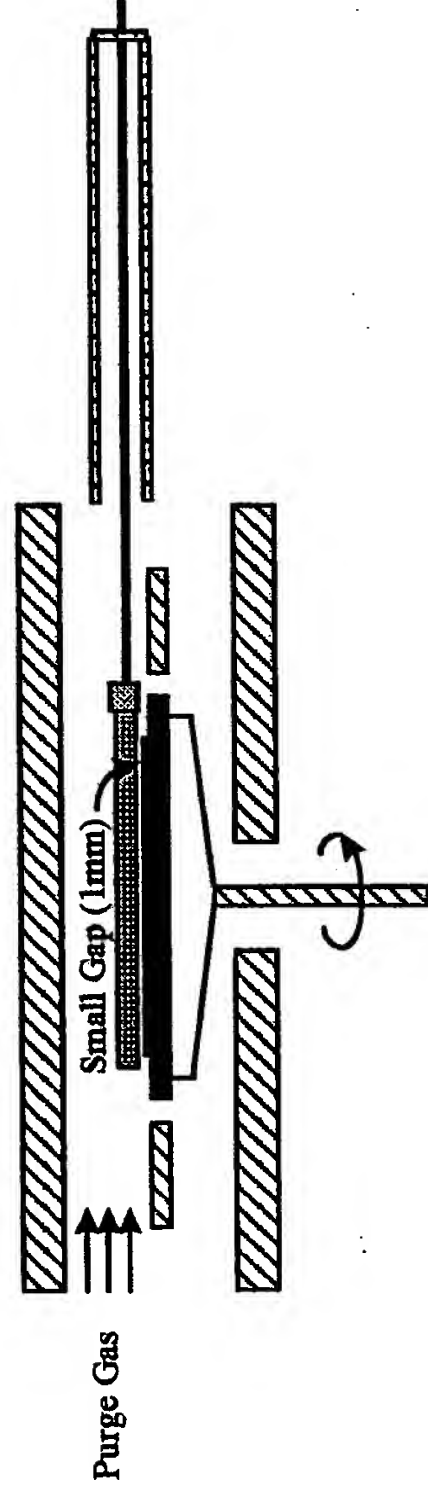
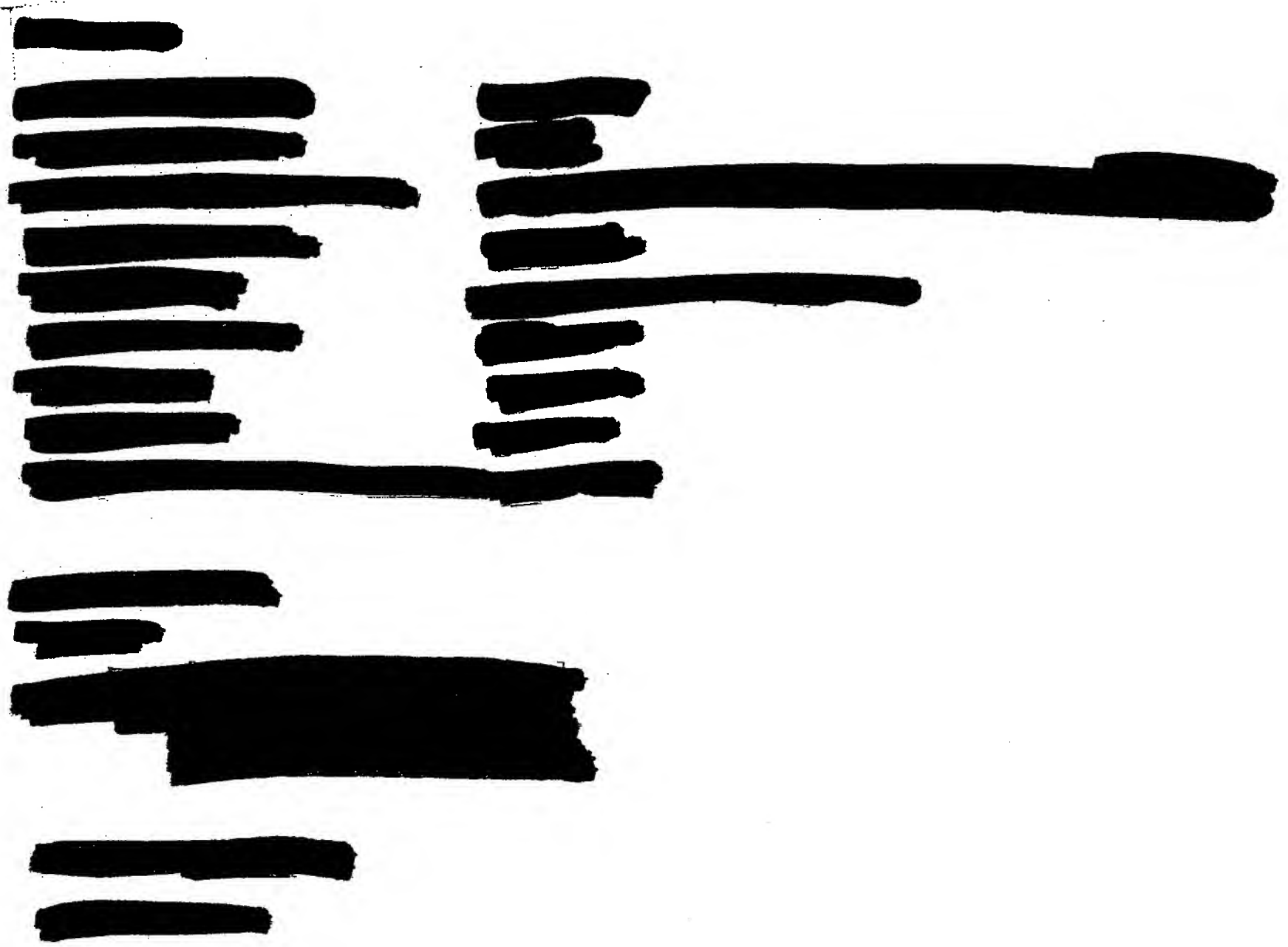
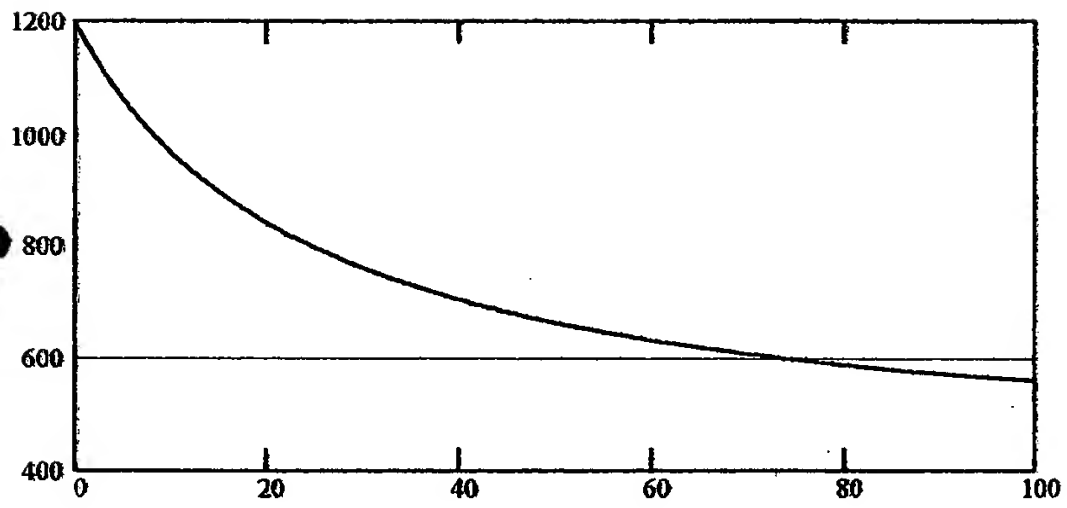


Fig 3a Spacing 2cm : current configuration.

COOL DOWN RATE OF SUSCEPTOR BY RADIATION AND CONDUCTION



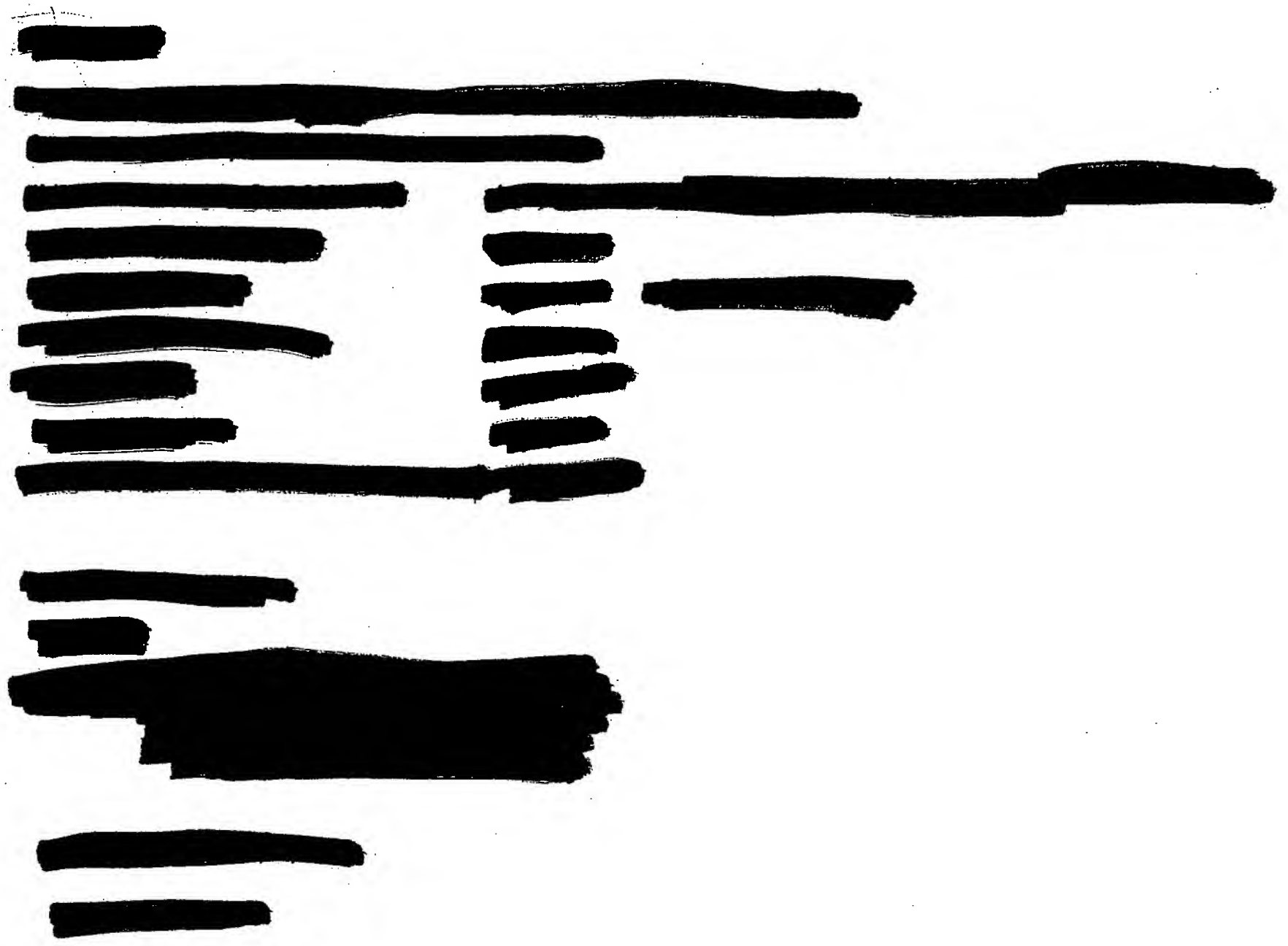
Temperature (c)



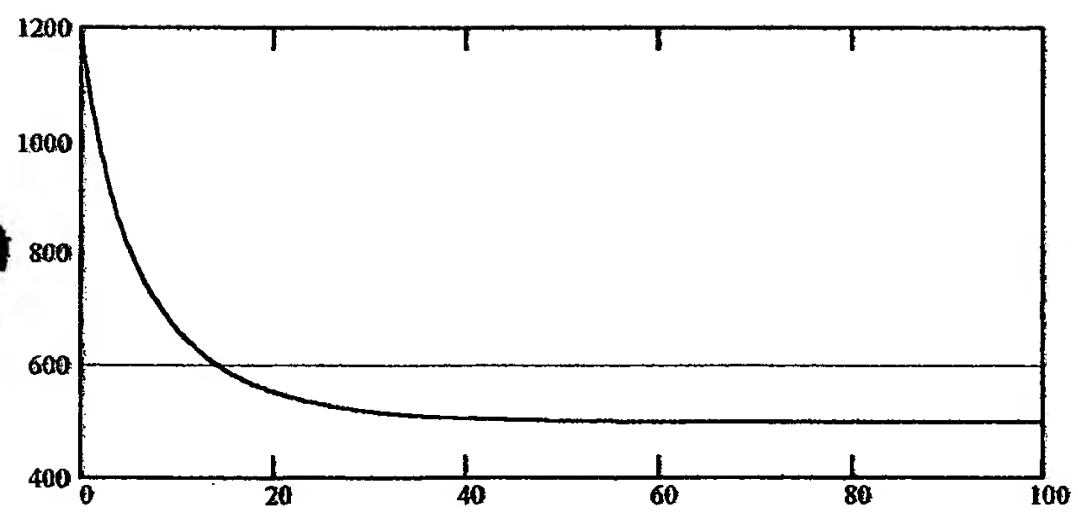
time (s)

Fig 3 b Spooling run: cool down close to quartz wall or cold plate

COOL DOWN RATE OF SUSCEPTOR BY RADIATION AND CONDUCTION



Temperature (C)



time (s)

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June 2, 1998

Ivo Raaijmakers
ASM AMERICA, INC.
3440 East University Drive
Phoenix, AZ 85034-7200

Re: U.S. Patent Application
Title: METHOD AND APPARATUS FOR COOLING SUBSTRATES
Our Reference: ASMEX.137A

Dear Ivo:

Enclosed is a draft of the patent application prepared in connection with the above-identified invention. Please carefully review the draft for accuracy and completeness, and make any corrections or additions directly on the draft and return it to us.

The patent laws require that the application describe the invention, and the methodology for making and using it, completely and accurately such that a person who has an ordinary amount of skill in the technology pertaining to this invention could, after reviewing the application, make and use the invention. Additionally, the patent laws require that the application set forth the preferred implementation or "best mode" of carrying out the invention. If the application would not permit such persons of ordinary skill to make and use the invention, or if you, at this time, know of a better way to make or use your invention than that which is described in the enclosed application, please add the information to the draft or otherwise let us know.

We will be listing you as sole inventor. If there is any question about inventorship, please advise.

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† ALSO MEMBER OF D.C. BAR
** ALSO BARRISTER AT LAW (U.K.)
*** U.S. PATENT AGENT

DVUTDTM D

Ivo Raaijmakers

June 2, 1998

Page -2-

As I believe you know, there is a duty to advise the Patent Office about prior information that is material to the patentability of the invention. Thus, please send us any such information that we do not have.

If you have any questions regarding any of the above, please call.

Sincerely,


Gordon H. Olson

Enclosures

cc: Russell N. Fairbanks, Jr., w/o encl.
Tony Komasa, w/encls.

GHO-9356:jr
060298

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MICHAEL J. GILLY
DANIEL E. JOHNSON**
JEFFERY KOEPKE
KHURRAM RAHMAN

August 31, 1998

VIA FEDERAL EXPRESS
803462669503

Ivo Raaijmakers
ASM AMERICA, INC.
3440 East University Drive
Phoenix, AZ 85034-7200

Re: U.S. Patent Application
Title: METHOD AND APPARATUS FOR
COOLING SUBSTRATES
Our Reference: ASMEX.137A

Dear Ivo:

Enclosed is the above-identified patent application, including drawings, with an attached Declaration by Inventors, an Assignment and a Power of Attorney Form.

United States patent laws require that the application describe the invention, and the method for making and using it, completely and accurately such that a person who has an ordinary amount of skill in the technology pertaining to this invention could, after reviewing the application, make and use the invention. Additionally, the patent laws require that the application set forth the preferred implementation or "best mode" of carrying out the invention. If the application would not permit such persons of ordinary skill to make and use the invention, or if you, at this time, know of a better way to make or use your invention than that which is described in the enclosed application, please let us know immediately.

Please carefully read the enclosed patent application in connection with the above requirements, and if there is anything in the application that appears to be incomplete or inaccurate, or that may be misleading, then contact us at once.

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** ALSO BARRISTER AT LAW (U.K.)
** U.S. PATENT AGENT

EXHIBIT C

Ivo Raaijmakers
August 31, 1998
Page -2-

If the application is accurate and complete in its present form, please read the Declaration which is attached to the back of the application. You must carefully consider certain matters before signing the Declaration.

The Declaration states that there is a duty to disclose information regarding earlier developments and the like which may be material to the examination of the application. If you know of such information now or learn of any while the application is pending in the U.S. Patent and Trademark Office, please advise us promptly.

Further, the Declaration states that you are an inventor of the subject matter which is claimed. If you have reason to believe that you may not be an inventor, or if you believe any inventors may have been omitted, please contact us immediately.

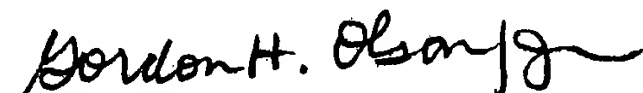
Finally, if there is anything in the Declaration or in these instructions which you do not understand, please let us know so that we can clarify the matter.

If corrections to the application are required, please make them directly on the enclosed patent application and return the corrected patent application copy to us. We will then amend the original to reflect the suggestions you make, and return the application to you for your signature before filing the application in the United States Patent and Trademark Office.

If the application is accurate and complete in its present form, please sign and date the enclosed Declaration in blue ink where indicated. Please note that the assignment must be notarized. Also, you should execute both the Declaration and the Assignment on the same day. The Power of Attorney should be signed by Russ Fairbanks on the same day or later than the Assignment, but not before. After execution, please return the papers to us for filing in the U.S. Patent and Trademark Office.

If you have any questions or comments, please call.

Sincerely,



Gordon H. Olson

Enclosures

cc: Russell N. Fairbanks, Jr.
Debbie Kelley

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